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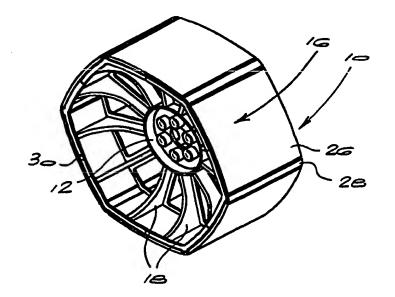
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(54) Title: COMPACTION ROLLER

(57) Abstract

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The invention concerns a soil compaction roller (10) and a soil compaction machine of which the roller (10) forms part. The roller (10) comprises a multi-sided. out-of-round, peripheral compacting surface (16) which can roll over a soil surface which is to be compacted. The compacting surface (16) is defined by a series of angularly spaced salient points (20) and a corresponding series of compacting faces (22). Each compacting face (22) is outwardly convex in shape and extends continuously between two adjacent salient points (20). When the roller (10) is operative with the compacting surface (16) rolling over the soil surface, the roller rises up on each salient point (20) in turn, storing potential energy, and thereafter rolls downwardly onto the succeeding compacting face (22) to transmit the stored potential energy to the soil surface to compact it. The instantaneous centre of rotation of the compacting surface (16), where it contacts the soil surface during rolling, moves continuously about substantially the full extent of the compacting surface.



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COMPACTION ROLLER

BACKGROUND TO THE INVENTION

THIS invention relates to a compaction roller.

Traditionally, soil compaction has been carried out either by means of round rollers with considerable mass or vibratory rollers. In relatively recent times, impact compaction as described in, for instance, the specification of United States patent US 2,909,106, has been used in soil compaction activities. Impact compactors have been demonstrated to achieve high levels of soil compaction at some depth below the surface but in some cases they may not be really effective for compaction of layer works where a relatively shallow surface zone of the soil mass has to be compacted. Depending on the soil conditions the impact roller of an impact compactors may have a tendency merely to disturb the surface layer rather than compact it effectively.

The impact roller of a conventional impact compactor may also have a tendency to create localised depressions in the soil surface, requiring subsequent smoothing operations them. They may also generate shock loads both on the towing tractor and on the soil mass and can have a relatively low operating speed.

SUMMARY OF THE INVENTION

According to the invention there is provided a soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted, the compacting surface being defined by a plurality of angularly spaced salient points and a corresponding plurality of compacting faces, each compacting face being outwardly convex in shape and extending continuously between two adjacent salient points.

Further according to the invention there is provided a soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted and which is defined by a plurality of angularly spaced salient points and intermediate compacting faces which are outwardly convex in shape and extend between the salient points, whereby when the roller is operative with the compacting surface rolling over the soil surface, the roller rises up on each salient point in turn, storing potential energy, and thereafter rolls downwardly onto the succeeding compacting face to transmit the stored potential energy to the soil surface to compact it, the instantaneous centre of rotation of the compacting surface, where it contacts the soil surface during rolling, moving continuously about substantially the full extent of the compacting surface.

The geometry of the roller is preferably such that the salient points are equiangularly spaced about a central axis of the roller and are equidistant from that axis, and each compacting face is symmetrical about a radial bisector of the two salient points between which the compacting face extends. The compacting face may be smoothly curved or composed of a plurality of flat facets which in combination form an outwardly convex shape. Another aspect of the invention provides a soil compaction machine comprising a soil compaction roller as summarised above. The machine may have a pair of the rollers arranged side by side with one another.

In the dual roller configuration there are various possibilities. For instance, the soil compaction rollers may be mounted on a common axle in the manner described for impact compaction rollers in ZA80/2099 (=EP 0 017 511). Alternatively the rollers may be suspended independently on separate axles as described for impact compaction rollers in PCT/IB99/00906. The machine may be self-propelled as described for an impact compaction machine in PCT/GB96/01708 (WO 97/04179), or it may include coupling means for coupling it to a tractive vehicle such as a tractor. The machine may also incorporate an auxiliary drive arrangement for delivering an auxiliary rotary driving force to the rollers as described for a dual roller impact compaction machine in PCT/GB98/01400 (WO 98/51866).

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of a compaction roller

according to this invention;

Figure 2 shows a side view of the compaction roller;

Figure 3 shows an end view of the compaction roller;

Figure 4 shows a cross-section at the line A-A in Figure 2; and

Figure 5

shows a soil compaction machine incorporating two compaction rollers, according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

The illustrated multi-sided compaction roller 10 has a central hub 12 located on a central axis 14 and a peripheral compacting surface 16 which is joined to the hub by radial spokes 18. The compacting surface 16 is defined by six salient points 20 which are equi-angularly spaced apart and equidistant from the central axis 14, and six intermediate compacting faces 22 extending between the salient points. The compacting faces 22 are identical to one another and each has a smooth, convex curvature which is symmetrical about a radial bisector of the two salient points 20 between which it extends. For example, the compacting face 22.1 is symmetrical about the radial bisector 24 of the two salient points 20.1.

The salient points 20 and faces 22 of the compaction surface 16 are formed by curved wear plates 26 and 28 respectively which are mounted to the ends of the spokes 18. The assembly of plates 26 and 28 is stiffened by ribs 30 which are located at the lateral edges of the plates and which are connected to the plates and to the lateral extremities of the spokes 18.

In operation of the compaction roller 10, the hub 12 is mounted on an axle supported by a carriage which is towed by a suitable towing vehicle, such as a tractor (not shown). In practice, there may be two similar compaction rollers arranged side by side. In this case the compaction rollers may be mounted on a common axle or they may be independently suspended.

The specification of South African patent ZA 80/2099 (= EP 0 017 511) describes an apparatus in which two impact compaction rollers are mounted side by side on a common axle. A similar mounting arrangement may be used to mount compaction rollers 10 on a common axle.

PCT/IB99/00906 describes an apparatus in which two impact compaction rollers are suspended independently in a side by side configuration and, once again, a similar mounting arrangement can be used for dual compaction rollers 10, as shown in Figure 5.

It is also within the scope of the invention for there to be a single compaction roller 10 only, in which case the roller may be mounted in the manner described in the specification of United States patent US 2,909,106.

It is also within the scope of the invention for the compaction roller(s) 10 to form part of a self-propelled machine which may, for instance, be of the type described in the specification of PCT/GB96/01708 (WO 97/04179).

EP 0 017 511, PCT/IB99/00906, US 2,909,106 and WO 97/04179 describe impact compaction machines in which each compactor mass, as it rolls over a soil surface which is to be compacted, alternately rises up on a salient point, storing potential energy, and then falls forwardly and downwardly for the stored potential energy to be delivered to the soil surface as an impact blow by a compaction face which follows the salient point. As mentioned previously, while this compaction technique has been proved to be effective to produce high levels of soil compaction at considerable depths below the soil surface, they have several disadvantages at least in some applications.

The compaction roller 10 does not act in the manner of an impact compaction roller. As it rolls over the soil surface, it rises up on each salient point 20 and then rolls forwardly and downwardly onto the succeeding compacting face 22. Potential energy which is stored as the roller rises on a salient point is applied to the soil surface as the roller rolls onto the succeeding face 22, but this happens in a far smoother manner than is the case with an impact compaction roller. This is attributable *inter alia* to the convex shape of the sides 22 which allows for a smooth transition from each raised, potential energy storage position to a succession of relatively lowered positions as the convex surface of the following face 22 rolls over the soil surface. The instantaneous centre of rotation, i.e. the point at which the compacting surface 16 makes line contact with the soil surface and about which the roller rotates instantaneously relative to the soil surface, moves continuously about substantially the full extent of the surface 16.

The action of the roller 10 may be likened to a continuous kneading action as opposed to the periodic impact action of an impact compaction roller.

The effect of this is that the soil surface experiences compacting pressure throughout the full rotation of the roller 10, i.e. at all angular positions of the roller. As the roller rises onto a salient point 22, the compacting pressure is experienced as a result of the reaction force applied to the soil surface by the roller, and as the roller subsequently rolls forwardly and downwardly onto a compacting face 22, the compacting force is experienced as a result of the stored potential energy being transmitted to the soil surface.

This action is in contrast to the action of an impact compaction roller. In the case of impact compaction rollers having flat sides, the only centres of rotation are at the salient points or corners of the roller.

There is no continuous movement of an instantaneous centre of rotation about the peripheral compacting surface of the roller. In the case of impact compaction rollers having a re-entrant recess between each salient point and the subsequent compacting face, the centre of rotation jumps from the salient point to an angularly spaced point on the compacting face. Hence there is once again no continuous, smooth motion of an instantaneous centre of rotation about the full extent of the peripheral compacting surface.

In contrast to the smooth and continuous application of compacting pressure to the soil surface with the roller 10, both types of impact roller mentioned above apply abrupt, non-continuous pressure spikes to the soil surface, resulting in disturbance of the soil mass adjacent the soil surface but often little effective compaction of that mass.

Because of its ability to apply smooth and continuous pressure to the soil surface, a roller 10, on the other hand, has been demonstrated in initial tests to have the ability to achieve effective compaction right to the surface of a soil mass. This makes the roller 10 eminently suitable for use in compacting layer-works.

Added to this, the smooth application of compacting pressure with the roller 10 results in a relatively smooth, compacted soil surface. This is again in contrast to the operation of an impact compaction roller, where localised indentations are created in the soil surface which must subsequently be smoothed, typically by blading.

With the illustrated roller 10 adequate levels of soil compaction can also be achieved without the substantial shock loads experienced in the operation of an impact compaction roller. This can in turn lead to reduced wear on the compactor itself and on surrounding equipment and structures.

A further advantage of the illustrated roller 10, when compared for instance to impact compaction rollers as seen in the specification of ZA 96/6036, arises from the symmetrical shapes of the sides 22 which allow the roller to be bi-directional, i.e. it can be rotated in either direction over the soil surface, and typically at higher rotational speeds than an impact roller, with comparable results. This is particularly important in cases where rollers 10 are used in a reversible, self-propelled machine.

In the preferred roller 10 the compacting faces are smoothly and convexly curved, but it is within the scope of the invention for these faces to be made up of a large number of narrow, flat facets defining, in combination, a generally convex surface.

PCT/GB98/01400 (WO 98/51866) describes an impact compaction machine which incorporates an auxiliary drive arrangement to apply an auxiliary rotary drive to the impact compactor masses or rollers of the machine. This may be necessary when, for instance, the salient points of the rollers have a tendency to dig into or slide on the soil surface. The auxiliary drive arrangement operates to restore the angular velocity of the rollers for normal operation to continue. It is also within the scope of the present invention for an auxiliary drive arrangement, similar to that described in WO 98/51866, to be incorporated in the compaction machine.

Various other modifications are also within the scope of the invention. For instance, while reference has been made to substantially continuous application of pressure to the soil surface and substantially continuous movement of the instantaneous centre of rotation about the full extent of the compacting surface, minor localised deformations, for instance recesses, in the compacting surface, can be tolerated while still achieving desirable levels of surface compaction.

CLAIMS

1.

A soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted, the compacting surface being defined by a plurality of angularly spaced salient points and a corresponding plurality of compacting faces, each compacting face being outwardly convex in shape and extending continuously between two adjacent salient points.

2.

A soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted and which is defined by a plurality of angularly spaced salient points and intermediate compacting faces which are outwardly convex in shape and extend between the salient points, whereby when the roller is operative with the compacting surface rolling over the soil surface, the roller rises up on each salient point in turn, storing potential energy, and thereafter rolls downwardly onto the succeeding compacting face to transmit the stored potential energy to the soil surface to compact it, the instantaneous centre of rotation of the compacting surface, where it contacts the soil surface during rolling, moving continuously about substantially the full extent of the compacting surface.

3.

A soil compaction roller according to either one of the preceding claims wherein the salient points are equi-angularly spaced about a central axis of the roller and are equidistant from that axis.

4.

A soil compaction roller according to claim 3 wherein each compacting face is symmetrical about a radial bisector of the two salient points between which the compacting face extends.

5.

A soil compaction roller according to any one of the preceding claims wherein each compacting face is smoothly curved.

6.

A soil compaction roller according to any one of claims 1 to 4 wherein each compacting face comprises a plurality of flat facets which in combination form an outwardly convex shape.

7.

A soil compaction roller according to any one of the preceding claims comprising a first series of wear plates defining the salient points and a second series of wear plates defining the compaction faces.

8.

A soil compaction roller according to claim 7 comprising a central hub and a plurality of spokes connecting the wear plates of the second series to the hub.

9.

A soil compaction roller according to claim 8 comprising stiffening ribs located internally of the wear plates at the lateral edges of the wear plates, the stiffening ribs being connected to the wear plates and to the spokes.

10.

A soil compaction machine comprising a soil compaction roller according to any one of the preceding claims.

11.

A soil compaction machine according to claim 10 which comprises a pair of the soil compaction rollers arranged side by side with one another.

12.

A soil compaction machine according to claim 11 wherein the soil compaction rollers are mounted on a common axle.

13.

A soil compaction machine according to claim 11 wherein the soil compaction rollers are suspended independently on separate axles.

14.

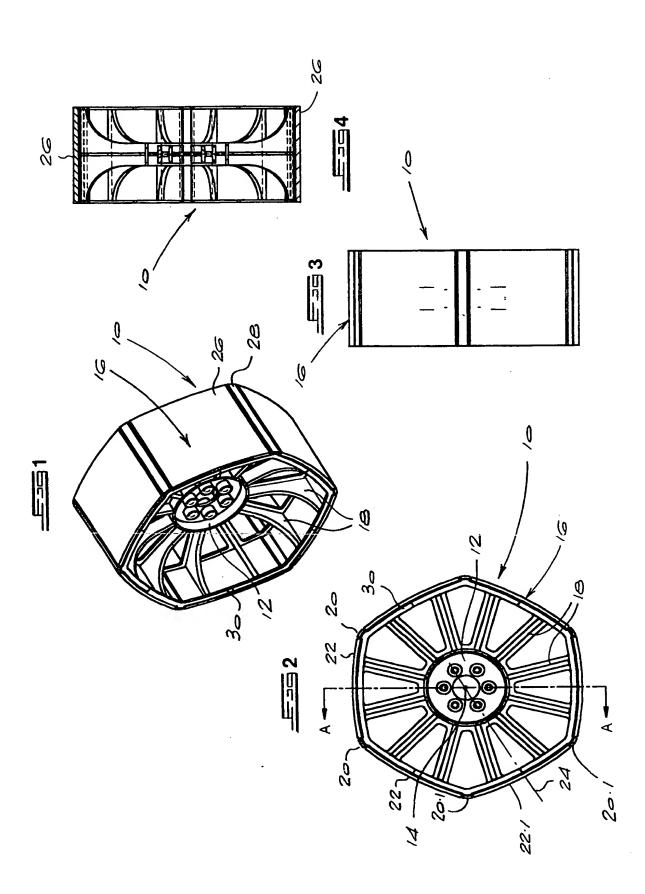
A soil compaction machine according to claim 11 which is self-propelled.

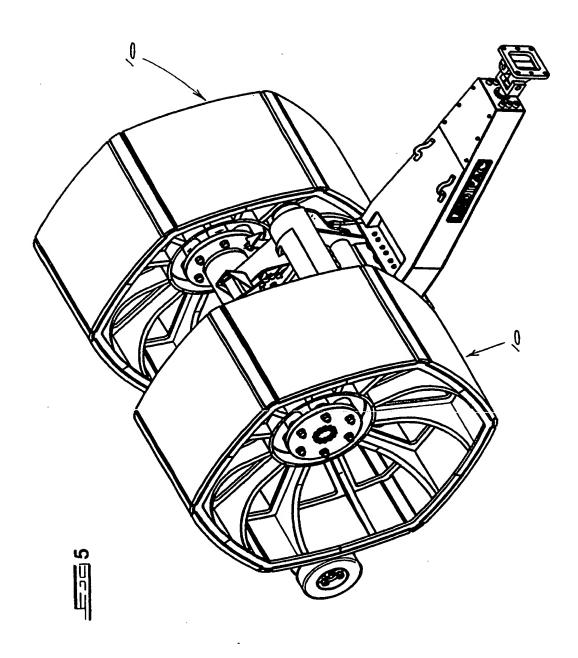
15.

A soil compaction machine according to claim 11 which includes coupling means for coupling the machine to a tractive vehicle.

16.

A soil compaction machine according to claim 11 and comprising means for delivering an auxiliary rotary driving force to each roller.





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(54) Title: TIRE FOR ROLLERS DESIGNED FOR COMPACTING SOIL

(54) Bezeichnung: BANDAGE FÜR WALZEN ZUR BODENVERDICHTUNG

(57) Abstract

The invention relates to a tire (5) for rollers, particularly vibrating rollers, designed for compacting soil, comprising a cover made of even sections (7). The tire is characterized in that the cover sections (7) have the shape of a triangle or trapezium. Adjoining sections (7) each share a side of a triangle or trapezium of the same length and are arranged in such a way that on the face of the tire (5), running in the direction of its circumference, the point of a triangle of a preceding cover section is followed alternately by the side of the triangle, situated opposite the corresponding point of a triangle, of the adjoining section.

(57) Zusammenfassung

Eine Bandage (5) für Walzen, insbesondere Vibrationswalzen, zur Bodenverdichtung weist einen Mantel aus ebenen Mantelabschnitten (7) auf. Sie ist dadurch gekennzeichnet, daß die Mantelabschnitte (7) die Form eines Dreiecks oder Trapezes aufweisen, wobei benachbarte Mantelabschnitte (7) jeweils eine gleich lange Dreieck- oder Trapezseite gemeinsam haben und so angeordnet sind, daß am den

Stirnseiten der Bandage (5) in deren Umfangsrichtung abwechselnd einer Dreiecksspitze eines vorhergehenden Mantelabschnitts eine einer entsprechenden Dreiecksspitze gegenüberliegende Dreiecksseite der anschließenden Mantelfläche folgt.

LEDIGLICH ZUR INFORMATION

Codes zur Identifizierung von PCT-Vertragsstaaten auf den Kopfbögen der Schriften, die internationale Anmeldungen gemäss dem PCT veröffentlichen.

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Bandage für Walzen zur Bodenverdichtung

Die Erfindung bezieht sich auf eine Bandage für Walzen, insbesondere Vibrationswalzen, zur Bodenverdichtung gemäß dem einleitenden Teil des Patentanspruchs 1.

Gegenüber den häufig anzutreffenden bekannten Walzenbandagen mit einem zylindrischen Mantel, die speziell auf Steigungen, aber auch bei ungünstigen Bodenverhältnissen eine schlechte Traktion im Gelände aufweisen und unter diesen erschwerten Betriebsbedingungen zum Schlüpfen neigen, haben Bandagen gemäß dem einleitenden Teil des Patentanspruchs 1 den Vorteil einer zuverlässigeren Traktion unter diesen erschwerten Bedingungen.

Bei den bekannten Bandagen dieser Art, die bisher nur bei statischen Walzen eingesetzt wurden, ist der Bandagenmantel aus rechteckigen Mantelabschnitten zusammengesetzt, deren lange Seitenkanten sich parallel zur Drehachse der Bandage erstrekken. Diese Mantelform bewirkt zwar die gewünschte zuverlässigere Traktion, weil die sich über die Bandagenbreite erstreckenden Knicklinien zwischen den ebenen Oberflächenabschnitten immer wieder in den Boden eingraben, doch besteht die erhöhte Traktion nur auf die Dauer des Eingriffs einer solchen Knicklinie in den Boden, während eine erhöhte Schlupfgefahr besteht, wenn der einer eingreifenden Knicklinie jeweils folgende ebene rechteckige Oberflächenabschnitt flach auf dem Boden aufliegt. Aus diesem Grunde eignen sich aus rechteckigen Flächenabschnitten gebildeten Bandagen auch nicht für eine Verwendung in Verbindung mit einer Vibrationswalze, bei der die Bandagen von einem eine Kreisschwingung oder eine gerichtete Schwingung erzeugenden Schwingungserreger in Vibration versetzt werden.

Die bekannten Bandagen mit einem aus rechteckigen ebenen Ab-

- 2 -

WO 98/24981

schnitten gebildeten Bandagenmantel haben auch den Nachteil eines beträchtlich ruckartigen Laufs, wobei die Ungleichförmigkeit um so größer ist, aus je weniger Rechtecken sich der Mantel zusammensetzt.

PCT/EP97/06795

Zur Verbesserung der Traktion ist im Stande der Technik auch vorgeschlagen worden, die Bandagenoberfläche mit Stollen zu versehen. Abgesehen von einer häufig nicht gewünschten übermäßigen Verformung an der Oberfläche des zu verdichtenden Bodens haben Stollenbandagen den großen Nachteil, daß sich das Verdichtungsgut zwischen den Stollen festsetzen kann und die Stollenbandage weitaus schwieriger zu reinigen ist als eine Bandage mit einer glatten oder aus ebenen Abschnitten zusammengesetzten Oberfläche.

Ausgehend von dem vorgenannten Stand der Technik liegt der Erfindungdie Aufgabe zugrunde, eine auch und insbesondere für den Einsatz bei Vibrationswalzen geeignete Bandage zu schaffen, die sich durch eine gegenüber zylindrischen Bandagen und auch gegenüber den bekannten Bandagen mit aus ebenen Abschnitten gebildetem Mantel wesentlich bessere Traktion und ferner durch einen gegenüber den letztgenannten bekannten Bandagen wesentlich besseren Rundlauf auszeichnet und zudem auch noch sehr leicht zu reinigen ist.

Die vorstehende Aufgabe wird durch die Merkmale des Patentanspruchs 1 gelöst.

Die erfindungsgemäße Bandagengestaltung bewirkt, daß sich im Betrieb der Bandage praktisch in jeder Winkelstellung von dieser mindestens eine Teillänge einer ihrer abgewinkelten, sich über die Bandagenbreite erstreckenden Knicklinien im Eingriff mit dem Boden befindet und so auch auf Steigungen für eine ununterbrochene im wesentlichen schlupffreie Traktion sorgt. Der ineinander übergehende Bodeneingriff der aufeinander folgenden

- 3 -

Bandagen-Knicklinien zwischen den ebenflächigen Mantelabschnitten ten hat im Vergleich zu den aus rechteckigen Mantelabschnitten zusammengesetzten Bandagen, bei denen die einzelnen Flächenabschnitte nacheinander ruckartig auf den Boden klappen, auch einen wesentlich gleichmäßigeren und runderen Lauf der Bandage zur Folge, und die flächigen Mantelabschnitte übertragen im Falle des Einsatzes von Schwingungserregern die Rüttelkräfte mit einem besonders hohen Wirkungsgrad in den Boden. Die Flächenauflast ist hierbei ähnlich wie bei Vibrationsplatten. Hinzu kommt, daß die hohe Linienlast an den Stoßstellen zwischen den einzelnen ebenen Mantelabschnitten den Verdichtungsvorgang noch weiter begünstigt.

Vorzugsweise sind die ebenen dreieckigen oder trapezförmigen Mantelabschnitte untereinander formgleich und haben jeweils die Form eines gleichschenkligen Dreiecks oder Trapezes wobei sie mit den gleich langen Schenkeln aneinander angrenzen.

Eine weitere bevorzugte Ausführungsform der erfindungsgemäßen Bandage besteht darin, daß mehrere aneinandergrenzende Mantelabschnitte aus einer gemeinsamen Platte durch Biegen von dieser hergestellt sind, wofür sich besonders gut die Biegetechnik mit Laserstrahl eignet.

Wie bei Verdichtungswalzen üblich, können auch bei einer Walze mit erfindungsgemäßen Bandagen diese einzeln über die ganze Walzenbreite reichen oder bei den einzelnen Achsen jeweils zu mehreren mit fluchtenden Drehachsen nebeneinander angeordnet sein.

Die Erfindung wird nachstehend anhand der Zeichnung an Ausführungsbeispielen noch näher erläutert.

In der Zeichnung zeigt jeweils in schematischer Darstellung:

WO 98/24981 PCT/EP97/06795

-4-

Fig. 1 eine zweiachsige Bodenverdichtungswalze mit je zwei erfindungsgemäßen Bandagen je Achse, in perspektivischer Ansicht,

Fig. 2a

bis 2d drei aus einer unterschiedlichen Anzahl von gleichschenkligen Dreiecken zusammengesetzte Bandagenmäntel, und zwar links jeweils in isometrischer Darstellung und rechts daneben in Ansicht von vorn,

Fig. 3a

- bis 3c drei weitere aus einer unterschiedlichen Anzahl von gleichschenkligen Dreiecken zusammengesetzte Bandagenmäntel, wobei in den einzelnen Figuren die unteren drei der übereinander befindlichen Darstellungen die betreffende Bandage in Ansicht von oben in verschienenen Winkelpositionen um ihre Drehachse gezeigt sind und die oberste Darstellung die jeweilige Bandage von vorne gesehen wiedergibt, und
- Fig. 4 eine Ausführungsform der Bandage, bei der die ebenen Mantelabschnitte, aus denen der Mantel zusammengesetzt ist, die Form von gleichschenkligen Trapezen haben.

Die in Fig. 1 sehr schematisch dargestellte Walze weist ein Walzengestell 1 auf, in dem die üblichen Antriebsaggregate und Steuerungen untergebracht sind. Unter dem Walzengestell 1 sind zwei Paare von jeweils in der Walzenmitte fliegend gelagerten Walzenbandagen jeweils gleichachsig angeordnet, wobei bei mindestens einer der beiden Achsen die Bandagen auf irgendeine bekannte Weise von dem Hauptantriebsaggregat im Walzengestell 1 her angetrieben sind und in ihnen in bekannter Weise Schwingungserreger angeordnet sein können, die die Bandagen 2a, 2b, 3a (in der Zeichnung nicht zu sehen) und 3b in Vibration versetzen können. Die einzelnen Bandagen 2a, 2b, 3a und 3b weisen

- 5 -

jeweils beidseitig Lagerschilde 4 und einen Bandagenmantel 5 auf, und sie sind, um Fahrachsen 6 drehbar, an dem in der Zeichnung nicht zu sehenden, in der Walzenmitte befindlichen und ggf. lenkbaren Bandagenträger gelagert.

Bei der Ausführung nach Fig. 1 ist jeder Bandagenmantel 5 aus zehn ebenen Mantelabschnitten 7 zusammengesetzt, von denen jeder die Form eines gleichschenkligen Dreiecks aufweist, wobei einander benachbarte Mantelabschnitte 7 jeweils eine gleich lange Dreiecksseite gemeinsam haben. Die ebenen, dreieckigen Mantelabschnitte 7 sind so angeordnet, daß an jeder Stirnseite der Bandage in deren Umfangsrichtung abwechselnd einer Dreiecksspitze 7a eines vorhergehenden Mantelabschnitts 7 eine Dreiecksseite 7b des anschließenden Mantelabschnitts 7 folgt und jeder Dreieckseite 7b auf einer der Bandagen-Stirnseiten auf der gegenüberliegenden Bandagen-Stirnseite eine Dreieckspitze 7a mittig gegenübersteht.

Die Fig. 2a bis 2c zeigen jeweils links in perspektivischer Darstellung und rechts in Ansicht von vorne verschiedene mögliche Mantelformen, wobei diejenige gemäß Fig. 2c im Prinzip den bei den Bandagen gemäß Fig. 1 verwendeten entspricht, jedoch eine größere Länge aufweist als diese und bei einer Bandage einsetzbar wäre, die an ihren beiden Stirnseiten gelagert ist und sich über die gesamte Walzenbreite erstreckt.

Weitere mögliche Bandagenmantelformen sind in den Fig. 3a - 3c dargestellt, wobei in den einzelnen Figuren übereinander die Bandagenmäntel 5 in Ansicht von oben in drei jeweils um eine halbe Kante gedrehten Winkelpositionen wiedergegeben bzw. - ganz oben - in Frontansicht dargestellt sind.

Den Frontansichten in Fig. 2a - 2c und Fig. 3a - 3c ist zu entnehmen, daß der Abstand, den die Symmetrielinie eines jeden Flächendreiecks von der Drehachse D der Bandage aufweist, ausWO 98/24981 PCT/EP97/06795

-6-

gehend von der Dreiecksseite 7b auf der einen Bandagenmantelstirnseite zur Ecke 7a auf der anderen, gegenüberliegenden Bandagenmantelstirnseite linear zunimmt, so daß die Knicklinien zwischen den Flächendreiecken 7 beim Abrollen der Bandage auf dem Boden allmählich von der einen zu der anderen Stirnseite hin in den Boden eingepreßt und danach wieder herausgeholt werden. Dies gewährleistet eine ununterbrochene, in der Regel schlupffreie, hohe Traktion, wobei auch, im Falle des Einsatzes von Schwingungserregern, die Rüttelkräfte optimal in den Boden eingeleitet werden.

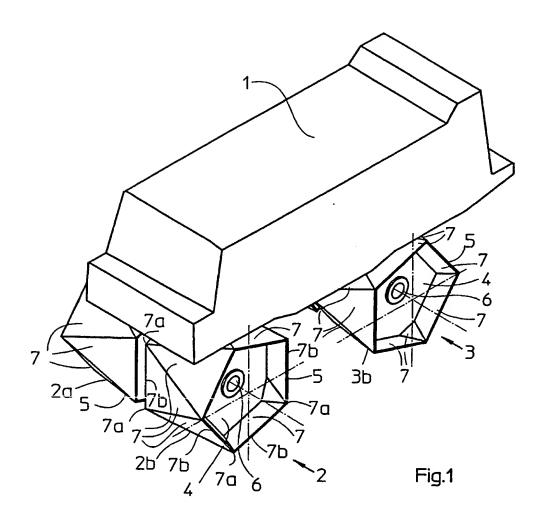
Die Fig. 4 zeigt eine Ausführung, bei der die ebenen Mantelabschnitte 7' aus gleichschenkligen Trapezen bestehen, bei ihnen also im Vergleich zu den Ausführungsformen gemäß Fig. 1 bis Fig. 3c die Ecke 7a des Dreieckes abgeschnitten ist, so daß an der entsprechenden Bandagenstirnseite eine kurze Trapezseite 7c vorhanden ist. Diese Bandagenmantelform ist leichter herstellbar, sei es durch Biegen des Mantelmaterials an den Knicklinien bei Herstellung mehrerer Flächenabschnitte 7' aus einem Stück, sei es durch Zusammenschweißen einzelner trapezförmiger Flächenabschnitten an den zusammenstoßenden Kanten.

WO 98/24981 PCT/EP97/06795

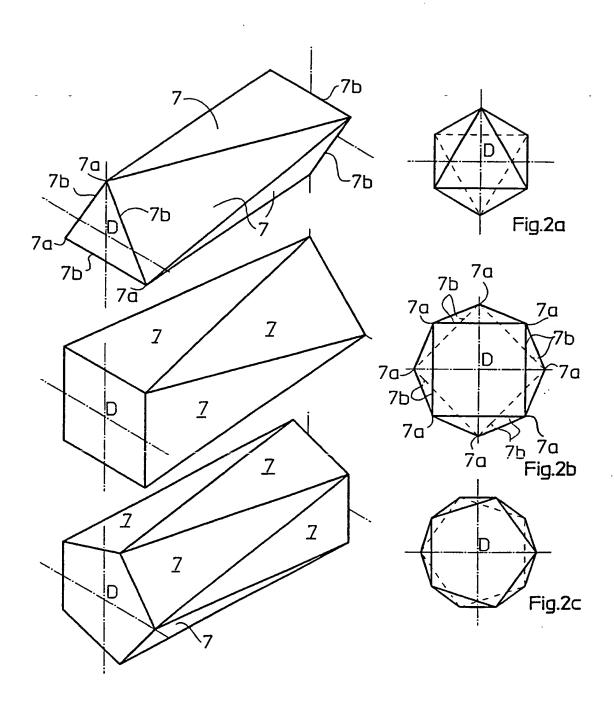
Patentansprüch

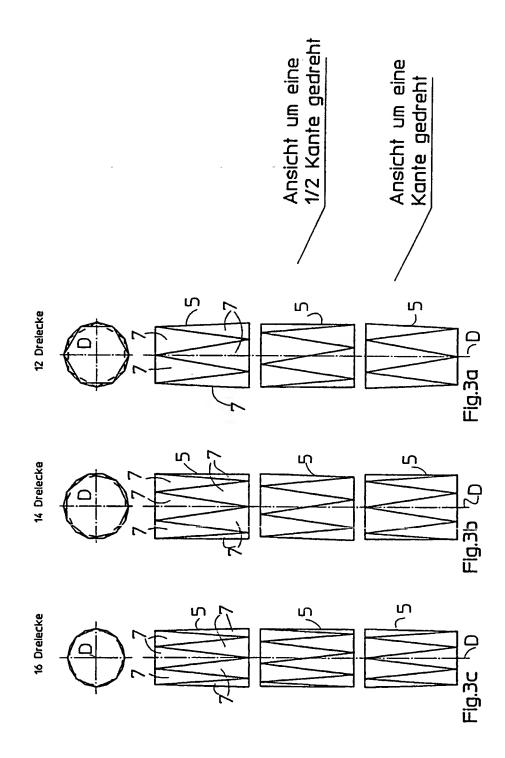
- 7 -

- 1. Bandage (5) für Walzen, insbesondere Vibrationswalzen, zur Bodenverdichtung, bei der der Bandagenmantel aus ebenen Mantelabschnitten gebildet ist, dadurch gekennzeichnet, daß die Mantelabschnitte (7) die Form eines Dreiecks oder Trapezes aufweisen, wobei benachbarte Mantelabschnitte (7) jeweils eine gleich lange Dreieck- oder Trapezseite gemeinsam haben und so angeordnet sind, daß an den Stirnseiten der Bandage (5) in deren Umfangsrichtung abwechselnd einer Dreieckspitze bzw. einer kürzeren Trapezseite eines vorhergehenden Mantelabschnitts eine einer entsprechenden Dreieckspitze bzw. kürzeren Trapezseite gegenüberliegende Dreieckseite bzw. längere Trapezseite der anschließenden Mantelfläche folgt.
- 2. Bandage nach Anspruch 1, dadurch gekennzeichnet, daß die untereinander formgleichen Mantelabschnitte jeweils die Form eines gleichschenkligen Dreiecks oder Trapezes haben und mit den gleich langen Schenkeln aneinandergrenzen.
- Bandage nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß mehrere Mantelanschnitte aus einer gemeinsamen Platte durch Biegen von dieser hergestellt sind.
- 4. Ein- oder mehrachsige Walze zur Bodenverdichtung mit Bandagen nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß bei den einzelnen Achsen jeweils mehrere Bandagen nach Anspruch 1 oder 2 mit fluchtenden Drehachsen nebeneinander angeordnet sind.



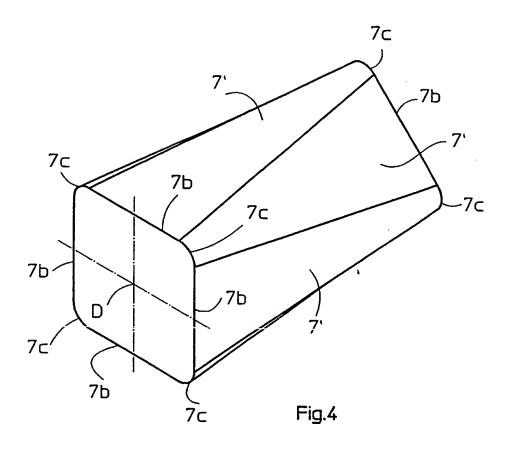
PCT/EP97/06795





WO 98/24981 PCT/EP97/06795

4/4



INTERNATIONAL SEARCH REPORT

Int. ional Application No PCT/EP 97/06795

A. CLASSIFICATION OF SUBJECT MATTER IPC 6 E02D3/026 B60B19/00						
	3.0 0 2020, 020 20021, 000					
According to	o International Patent Classification (IPC) or to both national classifica	tion and IPC				
B. FIELOS	SEARCHED					
Minimum documentation searched (classification system followed by classification symbols) IPC 6 E02D E01C A01B B60B B62D						
Documental	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched					
Electronic d	lata base consulted during the international search (name of data bas	se and, where practical, search terms used)				
,	· ·		•			
C. DOCUM	ENTS CONSIDERED TO BE RELEVANT					
Category °	Citation of document, with Indication, where appropriate, of the rele	vant passages Relevant t	o claim No.			
A	"Who says wheels have to be roun MACHINE DESIGN.,					
	vol. 43, no. 20, 19 August 1971, US,	CLEVELAND				
	page 110 XP002060024 					
Α	GB 441 375 A (EGNELL) 13 February see the whole document	1936				
						
Furth	her documents are listed in the continuation of box C.	Patent family members are listed in annex.				
* Special car	tegories of cited documents :	"T" later document published after the international filing date				
conside	ent defining the general state of the art which is not ered to be of particular relevance	or priority date and not in conflict with the application bu cited to understand the principle or theory underlying th invention				
filing d	are	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to				
which i	To one special reason (as specified)	involve an inventive step when the document is taken a "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when				
other n		document is combined with one or more other such documents, such combination being obvious to a person ski in the art.	u-			
later th	· · · · · · · · · · · · · · · · · · ·	*8.* document member of the same patent family				
	actual completion of theinternational search	Date of mailing of the international search report				
	4 March 1998	03/04/1998				
Name and m	nailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk	Authorized officer				
	Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Blommaert, S				

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INTERNATIONAL SEARCH REPORT

information on patent family members

Int Jonal Application No PCT/EP 97/06795

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P: cite	atent document d in search report	Publication date	Patent family member(s)	,	Publication date
GB	441375 A		NONE		
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INTERNATIONALER RECHERCHENBERICHT

Int .ionales Aktenzeichen
PCT/FP 97/06795

			1/11 3//00/35		
A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES IPK 6 E02D3/026 B60B19/00					
Nach der In	ternationalen Patentklassifikation (IPK) oder nach der nationalen Klas	ssifikation und der IPK			
B. RECHE	RCHIERTE GEBIETE				
Recherchier IPK 6	nter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbo E02D E01C A01B B60B B62D	ole)			
Recherchierte aber nicht zum MIndestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen					
Während de	Während der Internationalen Recherche konsuttierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegritte)				
C. ALS WE	SENTLICH ANGESEHENE UNTERLAGEN				
Kategorie®	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe	e der in Betracht kommenden	Teile Betr. Anspruch Nr.		
Α	"Who says wheels have to be roun MACHINE DESIGN., Bd. 43, Nr. 20, 19.August 1971, C US.		1		
	Seite 110 XP002060024				
A	GB 441 375 A (EGNELL) 13.Februar siehe das ganze Dokument	1936	1		
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	ere Veröffentlichungen sind der Fortsetzung von Feld C zu ehmen	X Siehe Anhang Pater	ntfamilie		
"A" Veröffer	ntlichung, die den allgemeinen Stand der Technik definiert,	oder dem Prioritätsdatun	die nach deminternationalen Anmeldedatum n veröffentlicht worden ist und mit der n, sondem nur zum Verständnis des der		
"E" älteres (icht als besonders bedeutsam anzusehen ist Dokument, das jedoch erst am oder nach dem internationalen	Erfindung zugrundellege	nden Prinzips oder der ihr zugrundeliegenden		
"L" Veröffen scheim	Anmeldedatum veröffentlicht worden ist "L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer				
anderen im Recherchenbericht genannten Veröffentlichung belegt werden "Y" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung soll oder die aus einem anderen besonderen Grund angegeben ist (wie kann nicht als auf erflinderischer Tätlickeit begubend betrachtet					
ausgeführt) "O" Veröffentlichung, die sich auf eine mündliche Offenbarung, "O" Veröffentlichung nieser Katengrie in Verbindung nebracht wird und					
"P" Veröffer	enutzung, eine Ausstellung oder andere Maßnahmen bezieht Hilichung, die vor dem Internationalen Anmeldedatum, aber nach eanspruchten Prioritätsdatum veröffentlicht worden ist	diese Verbindung für ein	en Fachmann nahellegend ist fled derselben Patentfamilie ist		
	Abschlusses der internationalen Recherche		nationalen Recherchenberichts		
24	4.Mārz 1998	03/04/1998			
Name und P	ostanschrift der Internationalen Recherchenbehörde Europäisches Patentamt, P.B. 5818 Patentiaan 2	Bevollmächtigter Bedien	steter		
	NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Blommaert,	S		
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INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichu...en, die zur seiben Patentfamilie gehören

Int. phales Aktenzeichen
PCT/EP 97/06795

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lm Re angeführ	echerchenbericht tes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
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# **PCT**

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's	or agen	's file reference		See Notification of Transmittal of International			
W/C/105	5		FOR FURTHER ACTION	Preliminary Examination Report (Form PCT/IPEA/416)			
Internation	al applica	ation No.	International filing date (day/mon	nth/year) Priority date (day/month/year)			
PCT/IB9	PCT/IB99/01784 08/11/1999			09/11/1998			
Internation E02D3/0		Classification (IPC) or	national classification and IPC	·			
COMPA	CTION	TECHNOLOGY (S	OIL) LIMITED et al.				
			mination report has been prepare according to Article 36.	ed by this International Preliminary Examining Authority			
2. This	REPOR	T consists of a total	of 6 sheets, including this cover	sheet.			
b (:	seen am	ended and are the b	asis for this report and/or sheets 607 of the Administrative Instruc	the description, claims and/or drawings which have containing rectifications made before this Authority ctions under the PCT).			
	<del></del>						
3. This	report c	ontains indications re	lating to the following items:				
1	⊠ e	Basis of the report					
II		Priority	·				
III		•	opinion with regard to novelty, in	o novelty, inventive step and industrial applicability			
IV		ack of unity of inven		•			
V	⊠ F	Reasoned statement itations and explana	under Article 35(2) with regard to tions suporting such statement	o novelty, inventive step or industrial applicability;			
VI	_	Certain documents o					
VII	⊠ (	Certain defects in the	international application				
VIII			on the international application				
Date of sub	omission	of the demand	Date o	of completion of this report			
25/05/20	00		16.02.	.2001			
		ddress of the internation	nal Author	rized officer			
	Europe D-8029	ean Patent Office 98 Munich	Nilsso	on, L			
Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465			· · · · · · · · · · · · · · · · · · ·	hone No. +49 89 2399 2460			

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IB99/01784

I. Basis	of the	report
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1. This report has been drawn on the basis of (substitute sheets which have been furnished to the receiving Of response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed the report since they do not contain amendments (Rules 70.16 and 70.17).): Description, pages:							
	1-8		as originally filed				
	Clai	ims, No.:					
	1-16	3	as originally filed				
	Dra	wings, sheets:					
	1/2-	2/2	as originally filed				
2.	With	h regard to the <b>language</b> , all the elements marked above were available or furnished to this Authority in the guage in which the international application was filed, unless otherwise indicated under this item.					
	The	se elements were a	available or furnished to this Authority in the following language: , which is:				
		the language of a	translation furnished for the purposes of the international search (under Rule 23.1(b)).				
		the language of pu	ublication of the international application (under Rule 48.3(b)).				
		the language of a 55.2 and/or 55.3).	translation furnished for the purposes of international preliminary examination (under Rule				
3.	With	th regard to any <b>nucleotide and/or amino acid sequence</b> disclosed in the international application, the ernational preliminary examination was carried out on the basis of the sequence listing:					
		contained in the in	ternational application in written form.				
		filed together with	the international application in computer readable form.				
		furnished subsequ	ently to this Authority in written form.				
		furnished subsequ	ently to this Authority in computer readable form.				
			t the subsequently furnished written sequence listing does not go beyond the disclosure in pplication as filed has been furnished.				
		The statement tha listing has been fu	t the information recorded in computer readable form is identical to the written sequence mished.				
4.	The	amendments have	e resulted in the cancellation of:				
		the description,	pages:				
		the claims	Nos :				

## INTERNATIONAL PRELIMINARY **EXAMINATION REPORT**

International application No. PCT/IB99/01784

		the drawings,	sheets:				
5. 🗆		This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):					
		(Any replacement sh report.)	eet containing such amendments must be referred to under item 1 and annexed to this				

- 6. Additional observations, if necessary:
- V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- 1. Statement

Novelty (N)

Yes:

Claims 3-9, 11-16

No:

Claims 1, 2, 10

Inventive step (IS)

Yes:

Claims

No:

Claims 3-9, 11-16

Industrial applicability (IA)

Yes:

Claims 1-16

Claims No:

2. Citations and explanations see separate sheet

#### VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted: see separate sheet

### VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made: see separate sheet



# **SECTION V**

1) Reference is made to the following documents:

D1: US-A-4 422 795 D2: US-A-3 662 658

2) The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and discloses (the references in parentheses applying to this document):

A soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted (see figure 1);

the compacting surface being defined by a plurality of angularly spaced salient points and a corresponding plurality of compacting faces (see figure 1 in combination with the description column 2, line 72 to column 3, line 5); each compacting face being outwardly convex in shape and extending continuously between two adjacent salient points (see figure 1).

The document D1 is also regarded as being the closest prior art to the subjectmatter of claim 2, and discloses (the references in parentheses applying to this document):

A soil compaction roller comprising a multi-sided, out-of-round, peripheral compacting surface which can roll over a soil surface which is to be compacted and which is defined by a plurality of angularly spaced salient points and intermediate compacting faces which are outwardly convex in shape and extend between the salient points (see argumentation under paragraph 2); whereby when the roller is operative with the compacting surface rolling over the soil surface, the roller rises up on each salient point in turn, storing potential energy, and thereafter rolls downwardly onto the succeeding compacting face to transmit the stored potential energy to the soil surface to compact it (see the description column 1, lines 13-21);

the instantaneous centre of rotation of the compacting surface, where it contacts the soil surface during rolling, moving continuously about substantially the full extent of the compacting surface. Therefore, the subject-matters of claims 1 and 2 can not be regarded as novel with respect to D1; Article 33 (2) PCT.

- 3) The subject-matter of claim 10 can not be regarded as novel with respect to document D1; Article 33 (2) PCT. (see figures in D1)
- 4) Inasmuch as the features of dependent claims 3-9 and 11-16 are not directly known from D1 and D2, they obviously concern only minor modifications thereto which come within the customary practice followed by a person skilled in the art and which cannot therefore be regarded as inventive (Article 33(3)PCT).

Consequently, dependent claims 4-9 and 11-16 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step.

#### **SECTION VII**

- 1) Claim 2 comprises all the features of claim 1 and is therefore not appropriately formulated as a claim dependent on the latter (Rule 6.4 PCT).
- 2) The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).
- 3) Independent claims 1, 2 and 10 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

#### **SECTION VIII**

1) Although claims 1 and 2 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-



# INTERNATIONAL PRELIMINARY **EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/IB99/01784

matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult, if not impossible, to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 1 and 2 do not meet the requirements of Article 6 PCT.

W



### INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference  FOR FURTHER  See Notification of Transmittal of International Search Report  (Form PCT/ISA/220) as well as, where applicable, item 5 below.								
W/C/105 International application No.	International filing date (day/month/year)	(Earliest) Priority Date (day/month/year)						
PCT/IB 99/01784	08/11/1999	09/11/1998						
Applicant	Applicant							
COMPACTION TECHNOLOGY (SO	IL) LIMITED et al.							
This International Search Report has been according to Article 18. A copy is being tra	n prepared by this International Searching Autlansmitted to the International Bureau.	nority and is transmitted to the applicant						
This International Search Report consists  X It is also accompanied by	of a total of2 sheets. a copy of each prior art document cited in this	report.						
Basis of the report								
	international search was carried out on the bar less otherwise indicated under this item.	sis of the international application in the						
the international search w Authority (Rule 23.1(b)).	ras carried out on the basis of a translation of t	he international application furnished to this						
b. With regard to any nucleotide an was carried out on the basis of the		nternational application, the international search						
	onal application in written form.							
	ernational application in computer readable for	n.						
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1 =	this Authority in computer readble form.	to a control to a control that affect according to the						
	osequently furnished written sequence listing one side that has been furnished.	loes not go beyond the disclosure in the						
the statement that the info	ormation recorded in computer readable form i	s identical to the written sequence listing has been						
2. Certain claims were fou	nd unsearchable (See Box I).	·.						
3. Unity of invention is lac	king (see Box II).							
4. With regard to the title,								
the text is approved as su	ibmitted by the applicant.							
the text has been established by this Authority to read as follows:								
5. With regard to the abstract,								
the text is approved as su the text has been establis	shed, according to Rule 38.2(b), by this Author	ity as it appears in Box III. The applicant may,						
within one month from the	e date of mailing of this international search re	port, submit comments to this Authority.						
6. The figure of the drawings to be pub	lished with the abstract is Figure No.	1						
as suggested by the appl	icant.	None of the figures.						
because the applicant fail								
because this figure better characterizes the invention.								

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		101/10 99/01/04
A. CLASSIFICATION OF SUBJECT MATTER IPC 7 E02D3/026 E02D3/046		
According to International Patent Classification (IPC) or to both national c	dassification and IPC	
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classific 7 E02D E01C	ssification symbols)	
Documentation searched other than minimum documentation to the exten		
Electronic data base consulted during the international search (name of d	ata base and. where practical, se	earch terms used)
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category * Citation of document, with indication, where appropriate, of	the relevant passages	Relevant to claim No.
X US 4 422 795 A (BERRANGE AUBRE 27 December 1983 (1983-12-27) column 3, line 6 -column 5, li figures 1-5	_ · · · · ·	1-3,5, 10-12,15
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A column 2, line 67 -column 7, l		11,15
Further documents are listed in the continuation of box C.	X Patent family men	bers are listed in annex.
"Special categories of cited documents:  "A" document defining the general state of the art which is not considered to be of particular relevance  "E" earlier document but published on or after the international filling date  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)  O" document referring to an oral disclosure, use, exhibition or other means  P" document published prior to the international filling date but later than the priority date claimed	or priority date and not cited to understand the invention  "X" document of particular reannot be considered involve an inventive structurary cannot be considered to cannot be considered to document is combined	d after the international filling date in conflict with the application but principle or theory underlying the elevance; the claimed invention novel or cannot be considered to pe when the document is taken alone elevance; the claimed invention o involve an inventive step when the with one or more other such document is underlying the with one or more other such document in being obvious to a person skilled e same patent family
Date of the actual completion of the international search		ternational search report
27 January 2000	04/02/2000	)
lame and mailing address of the ISA  European Patent Office, P.B. 5818 Patentlaan 2  NL - 2280 HV Rijswijk  Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3018	Authorized officer Tellefsen	J

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